

BRIEF NOTE

A Gravity Reference Station at Wright State University¹

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ABSTRACT. An absolute gravity reference station has been established in a publicly accessible area of the Wright State University campus, in Fairborn, OH. A new station was needed for the area because the previous stations were either found to be faulty or were in a restricted access area of Wright-Patterson Air Force Base. The gravity value is 980 074.51 \pm 0.2 milligals.

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INTRODUCTION

Gravity surveys are almost always conducted with instruments which very precisely measure differences in the gravitational field, rather than the absolute value of the field. Absolute gravity measurements are too expensive and time consuming to use for normal surveys with hundreds to thousands of measurement stations. Because of this distinction between relative and absolute gravity measurements, a national network of absolute gravity stations is available to which relative gravity measurements can be referenced. In Ohio the state-wide survey of Heiskanen and Uotila (1956) has been frequently used for tying relative measurements to national absolute gravity values.

At Wright State University Heiskanen and Uotila's Station No. 600 in Fairborn has been used for referencing a number of local surveys. Recently we discovered that the published data for this station was not self consistent. Repeating the calculation starting with observed gravity and proceeding to free air and Bouguer anomaly gives different values than those published. Because we could not find supporting data for the publication, we were unable to determine which values were correct. Additionally, commercial development in the area has destroyed the original benchmark and made the site too noisy and congested for a good reference station.

The Defense Mapping Agency (1994) has a national network of absolute gravity stations but the only two in the Fairborn area are near the flight line of Wright-Patterson Air Force Base. This is a restricted area and so these stations are not available for routine work. We decided it was desirable to establish a new absolute gravity reference station that would be accessible to anyone working in the area. Permission was obtained to take measurements at one of the Wright-Patterson AFB gravity stations for the purpose of setting up this off-base reference station.

MATERIALS AND METHODS

New Reference Station Location

The new reference station is identified by a brass disk mounted in the pavement 4.9 m at a bearing of N36°W from the southeast corner of the Geological Sciences Field Equipment Building off Kauffman Avenue on the Wright State University campus. It is in an area with public access. The location coordinates were scaled from the USGS Fairborn, OH, 7.5 minute quadrangle map. The latitude and longitude are 39° 47' 23" N and 84° 3' 4" W, respectively. The Universal Transverse Mercator location is 16SGV52720837.

The elevation of the station was surveyed with a level and referenced to a Greene County Engineers benchmark on the Kauffman Avenue bridge which is just west of the Longstreet Lane intersection. The elevation is 254.13 \pm 0.03 m (833.8 \pm 0.1 ft).

Gravity Measurements

A LaCoste-Romberg Model G gravimeter was used for determining the gravity differences between the stations. The instrument calibration is 1.05887 milligals per scale unit. (One milligal corresponds to a gravitational acceleration of 0.001 cm/s².) A loop procedure was followed which made measurements at the Wright-Patterson AFB gravity station (reference code DOD 0873-0) four times in two hours and eight minutes. Between each pair of these readings, measurements were taken at Heiskanen and Uotila's Station No. 600 and at the new reference station. The variation of the readings at the WPAFB station was nearly linear in time and the total drift, which is the result of diurnal tidal effects and instrument drift, was +0.05 milligal. The first base station reading was used as the reference value. The interpolated base variation at the time of each of the other station readings was determined. This change was subtracted from the station reading expressed in milligals to give the corrected readings as if all had been measured at the initial time. After correcting for this drift, the three readings at each stations were consistent to within \pm 0.02 milligal. This is the limit of the reading precision of the meter.

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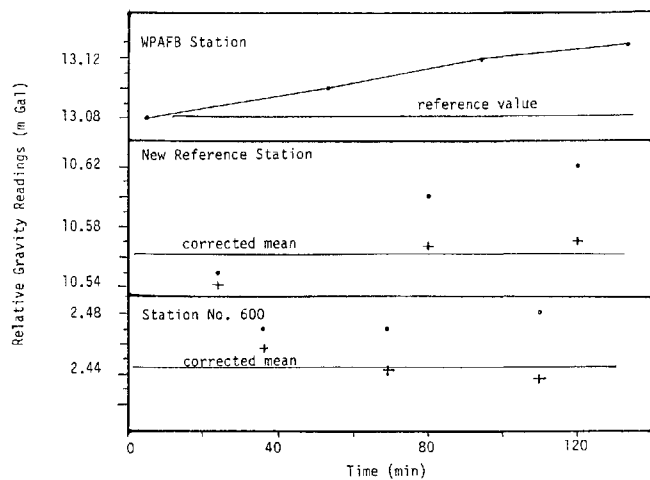


FIGURE 1. Time dependence correction on gravity readings (• for original readings, + for corrected readings). Top shows WPAFB station readings and reference value used. Middle shows readings and mean of corrected value at New Reference Station. Bottom shows readings and mean corrected value at Heiskanen and Uotila Station 600.

RESULTS AND DISCUSSION

The absolute gravity at Wright-Patterson AFB Station DOD 0873-0 is given by the Defense Mapping Agency (1994) as 980 077.03 \pm 0.2 milligals. The other stations were referenced to this value using the corrected and averaged difference measurements (Fig. 1). The gravitational field at the new reference station is 980 074.51

milligals. The revised value for Heiskanen and Uotila's Station No. 600 is 980 066.39 milligals which is 14.95 milligals lower than the published value. These values use the International Gravity Standardization Net 1971 (Morelli 1971). The original Heiskanen and Uotila survey was referred to the older Potsdam Gravity System which makes all of their stations 14 milligals higher than the Defense Mapping Agency values. Thus, the published observed gravity value was correct to within one milligal of our remeasurement. The main errors in the publication were the calculated anomaly values. The accuracy of the differences we measured is better than \pm 0.02 milligal. However, the reported accuracy for the Wright-Patterson AFB station is \pm 0.2, so the absolute accuracy of the values we report is \pm 0.2 milligals.

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